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Abstract

PRELIMINARY STUDIES ON THE CLOSED CYCLE MAGNETOAERODYNAMIC CONVERTER

This report deals with the work performed at the Saclay Center [1] of "Commissariat à l'Energie Atomique" and at the Fontenay Center [2] of "Electricité de France"

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Besides the open cycle MHD converters which convert the thermal energy contained in combustion gases a closed cycle converter which can work with any high temperature heat source and specially with nuclear sources is being very carefully studied.

Before proceeding to a practical study of the power station as a whole the performances of the converter itself must be fully investigated. These performances are largely a function of the conductivity of the gas, but this conductivity must not be repaid by a temperature technically unacceptable for the heat exchanger.

In the conversion fluid an ionizable seeding vapour such as caesium or potassium is mixed with a carrier gas, helium or argon. Purely thermal ionization is only efficient above 2 500°K, whereas the electric field obtained by induction in the converter can, under given conditions, increase the electron temperature and produce an ionization rate well above the equilibrium value. This allows the gas to be ionized at moderate temperature. Studies are under way in order to clarify the conditions required to produce extra-thermal ionization in seeded rare gases.

Translation provided by courtesy of the submitting Government

Measurements have been performed with a 3-phase 500 kVA [2] plasmatron with potassium-seeded argon. The outgoing gas is fed into a channel where the tensor components of conductivity are measured in the presence of a magnetic field. The values found under thermodynamic equilibrium conditions confirm the simple theory. This is not the case when the electrons are heated.

Measurements of the same kind have been made by another method [1] in caesium-seeded helium contained in an isothermal vessel at 1 900°K. There also the equilibrium values are in good agreement, but non-equilibrium ionization seems to be lower than expected.

The effect of electron heating inside the converter in the case of argon-potassium mixture has been considered in a theoretical study [2] . It is shown that the electrode set must be carefully subdivided along the channel, and that electron heating in argon-potassium can be achieved by magnetic fields from 1 to 2 Ts.

Plans are being made to build an important facility [1] which will work on the principle of hot shots. The gas generator will deliver caesium-seeded helium shots at a temperature of 2 100°K. The shot will last 1/10 s and the instantaneous thermal power will reach 1 MW.